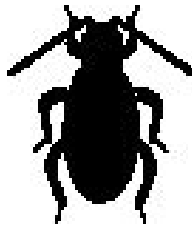




High School Biology

Saga of the Bark Beetle



INTRODUCTION

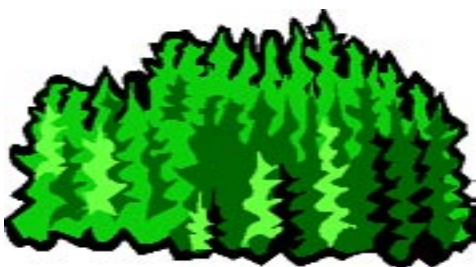
Good morning/afternoon. My name is _____, and I work for the _____

National Forest. Today we are going to be talking about a biological topic that has gotten a lot of attention in recent years – the bark beetle. How many of you have heard of the bark beetle?

LESSON

Pine bark beetles are among the most important tree killing agents in Southwestern pine forests. In some years, these insects kill thousands of pinyon pines and ponderosa pines. In fact, in recent years, hundreds of thousands of trees have been killed in the local area by bark beetles. On the _____ National Forest, we are now counting the number of dead trees due to the beetles in the millions!

These insects are native to the Southwest, and they normally play a beneficial role in pine ecosystems by acting as a natural thinning agent on trees weakened by factors such as fires, high winds, storms or heavy snow. These insects begin the lengthy decomposition process that returns the tree material back to the soil. Also, a variety of wildlife feeds on these beetles, and beetle-killed trees serve as nesting sites. Even though the beetles are natural to this area and have beneficial roles, they are considered pests when they kill trees people want to preserve. That is what has been happening here locally in recent years. Because our forests are overly crowded with trees and are drought-stricken, we've seen an explosion in the beetle population. Does anyone know why an over-crowded and drought-stricken forest would be more susceptible to



FOREST SERVICE MESSAGES

- A-3:** Leaving nature alone has consequences, risks and trade-offs.
- A-4:** All components of the environment function as a dynamic, interdependent and interrelated system.
- C-3:** Forest conditions now are not natural or healthy.
- C-4:** Because of unnaturally dense conditions, our forests are at risk for destructive wildland fires, insect infestations and diseases.
- C-6:** The Forest Service cuts trees to accomplish specific objectives within the ecosystem such as reducing the risk of wildland fire, enhancing dwindling aspen stands, restoring grasslands, and improving forest health and wildlife habitat.
- C-7:** The Forest Service manages for biodiversity, not single species.
- C-8:** Doing nothing is not always the right answer. The Forest Service alone cannot know the right answer, but by collaborating with the public, we can come closer to it.
- C-9:** Prescribed fire is one tool the Forest Service uses to meet ecosystem goals.

ACADEMIC STANDARDS



Arizona Standards

SCIENCE

- 1SC-P1:** Propose solutions to practical and theoretical problems by synthesizing and evaluating information gained from scientific investigations
- P0 2:** Propose solutions to a problem, based on information gained from scientific investigations
- 1SC-P3:** Analyze and evaluate reports of scientific studies
- P0 1:** Analyze reports of scientific studies for elements of experimental design
- P0 2:** Compare conclusions to original hypotheses
- P0 3:** Evaluate validity of conclusions
- 2SC-P6:** Analyze evidence that supports past and current scientific theories about a specific topic
- P0 1:** Distinguish between evidence which supports a given scientific theory (e.g., model of the atom, plate tectonics, natural selection) and evidence which does not support the theory
- 3SC-P1:** Apply scientific thought processes and procedures to personal and social issues
- P0 1:** Apply scientific thought processes of skepticism, empiricism, objectivity and logic to seek a solution to

beetle infestation? Well, it has to do with how trees defend themselves against bark beetle attack. The only defense a tree has is to “pitch” the beetles out as they try to bore into the tree’s bark. Has anyone seen pitch on trees? The only way a tree can produce pitch is by taking in a sufficient amount of water. When there are too many trees in the forest, the trees are all competing for a limited amount of water and nutrients. Eventually, the trees become stressed because they aren’t getting enough water. Stressed trees aren’t able to produce sufficient pitch and are thus unable to defend themselves against attack. Drought conditions just exacerbate this situation.

So, how do you know if a tree has been attacked by bark beetles? Fading foliage on a tree is often the first sign of a beetle attack. The needles change from green to a light straw color within a few weeks to a year after an

attack and eventually become yellowish-brown or orange-red in color. You may also see a fine boring dust in the bark crevices and at the base of the tree. It looks kind of like sawdust. Also, small pitch tubes or globules of pitch may appear on the trunk of live trees that have been attacked. This doesn’t mean that the tree is definitely going to die, though. The pitch could be evidence that the tree successfully defended itself against beetle attack. Remember that pitch is the way the tree defends itself against beetle attack. The real key to knowing if a tree is infested with beetles is to remove a section of bark. If the tree is infested, you will see the characteristic beetle galleries. I’ll explain more about what these galleries are a little later. But, for now, let’s take a look at them!



These photos were taken at a public meeting on bark beetles that was held in Tusayan, Arizona. Attendees learned about bark beetles and were able to look at beetles and their galleries.

personal and social issues

P0 2: Apply a scientific method to the solution of personal and social issues

3SC-P4: Identify and describe the basic processes of the natural ecosystems and how these processes affect, and are affected by, humans

P0 1: Describe the basic processes of the natural ecosystems (e.g., water cycle, nutrient cycles)

P0 2: Explain how these processes affect, and are affected by, humans

3SC-P5: Describe and explain factors that affect population size and growth (e.g., birth and death rates, quality of environment, disease, education)

P0 1: Describe biotic and abiotic factors that affect populations

P0 2: Predict the effect of a change in a specific factor on a population

4SC-P6: Describe and explain how the environment can affect the number of species and the diversity of species in an environment

P0 1: Explain how the adaptations of various species are related to their success in an ecosystem

P0 3: Predict how a change in an environmental factor can affect the number of organisms in a population

LANGUAGE ARTS

R-P1: Apply reading strategies such as extracting, summarizing, clarifying, and interpreting information; predicting events and extending the ideas presented; relating new information to prior knowledge; supporting assertions with evidence; and making useful connections to other topics to comprehend works of literature and documents

P0 1: Extract critical details or elements of literature

P0 2: Summarize the main points

P0 3: Make predictions based on evidence presented

P0 4: Extend ideas presented in the text

P0 5: Connect prior knowledge to information available

W-P2: Write a persuasive essay (e.g., an editorial, a review, an essay, a critique) that contains effective introductory and summary statements; arranges the arguments effectively; and fully develops the ideas with convincing proof, details, facts, examples and descriptions

P0 1: Write a thesis statement to convey a point of view about a subject

P0 2: Develop the point of view with ample and convincing support (e.g., details, facts, reasons, examples and descriptions) appropriate to audience and purpose

P0 3: Create an organizational structure that includes an effective beginning, middle and ending

P0 4: Use persuasive word choice and sentence structure (e.g., connotation, strong verbs, repetition and



ACTIVITY

(Pull out a couple of pieces of bark with galleries. Let the students come up and look at them.)

LESSON

Now that you've seen a beetle gallery, what do you think they are used for? Well, it all has to do with the bark beetle's life

cycle. Beetles generally produce two to four generations per year, depending on the climate and elevation of the area being attacked. In the spring, adult beetles emerge from material infested the previous fall and fly to attack new host trees. Beetles prefer fresh debris from logging, construction activity or natural events like drought. During these outbreaks, live trees may be attacked, especially those located adjacent to fresh slash. Also, trees weakened by drought, disease, overcrowding or damage are extremely vulnerable to attack, as we discussed earlier.

Males initiate attacks by boring through the outer bark and then tunneling into the soft, inner bark of the tree. The males then release chemical messengers – called pheromones – to attract females.

So, the male beetles find a weak tree and attack it. Then they basically call all their beetle buddies and say, "Hey, here's an easy tree to attack. Come help." Then, the adult beetles create tunnels under the bark

called "egg galleries" and lay eggs alongside their galleries. Eggs hatch in about a week. White, worm-like larva hatch and feed on the inner bark for six to eight weeks before they pupate. Adults develop from pupae and then emerge by boring out through the bark. The cycle then starts again. The new, adult beetles fly to another, usually nearby, tree and call for their



Learning about bark beetles

parallelism)

LS-P2: Deliver an impromptu speech that is organized, addresses a particular subject and is tailored to the audience



New Mexico Standards

SCIENCE

Strand I: Scientific Thinking and Practice

Standard I: Understand the processes of scientific investigations and use inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically.

9-12 Benchmark I: Use accepted scientific methods to collect, analyze, and interpret data and observations and to design and conduct scientific investigations and communicate results.

Grade 9-12 Performance Standards

4. Convey results of investigations using scientific concepts, methodologies, and expressions, including:
 - clear, logical, and concise communication
 - reasoned arguments.
5. Understand how scientific theories are used to explain and predict natural phenomena (e.g., plate tectonics, ocean currents, structure of atom).

9-12 Benchmark II: Understand that scientific processes produce scientific knowledge that is continually evaluated, validated, revised, or rejected.

Grade 9-12 Performance Standards

6. Examine the scientific processes and logic used in investigations of past events (e.g., using data from crime scenes, fossils), investigations that can be planned in advance but are only done once (e.g., expensive or time-consuming experiments such as medical clinical trials), and investigations of phenomena that can be repeated easily and frequently.

Strand II: The Content of Science

Standard II (Life Science): Understand the properties, structures, and processes of living things and the interdependence of living things and their environments.

9-12 Benchmark I: Understand how the survival of species depends on biodiversity and on complex interactions, including the cycling of matter and the flow of energy.

Grade 9-12 Performance Standards

Ecosystems

1. Know that an ecosystem is complex and may exhibit

These photos show the bark beetles that are causing damage to ponderosa pine trees in the Southwest. Here is shown an adult Ips and an adult western pine beetle.

These photos were taken by the Forest Service Health Protection staff.



friends. Several overlapping generations may occur through the summer and fall until colder temperatures arrive. When temperatures drop, the beetles overwinter under the tree's bark.

So now we know how the beetles attack, but can anyone tell me how the beetles actually kill the tree? Well, it is a combination of factors. First, the boring activity of the adult beetles and the feeding of the larva on the inner bark helps to kill the tree by girdling it. When a tree is "girdled," it basically means that the tree is no longer able to carry water and nutrients through its system. Also, beetles carry a fungi on their bodies. This fungi is



Here we see a larva, pupa, and adult stage of Ips.

often called blue-stain fungi. Once the beetles attack a tree, this fungi begins to grow in the wood, which clogs the tree's water conducting system. So, in simple terms, the tree eventually dies because it is no longer able to provide itself with water and nutrients.

Let's take a look at these tree-killing machines!

fluctuations around a steady state or may evolve over time.

2. Describe how organisms cooperate and compete in ecosystems (e.g., producers, decomposers, herbivores, carnivores, omnivores, predator-prey, symbiosis, mutualism).
3. Understand and describe how available resources limit the amount of life an ecosystem can support (e.g., energy, water, oxygen, nutrients).
4. Critically analyze how humans modify and change ecosystems (e.g., harvesting, pollution, population growth, technology).

Biodiversity

8. Understand and explain the hierarchical classification scheme (i.e., domain, kingdom, phylum, class, order, family, genus, species), including:
 - classification of an organism into a category
 - similarity inferred from molecular structure (DNA) closely matching classification based on anatomical similarities
 - similarities of organisms reflecting evolutionary relationships.
9. Understand variation within and among species, including:
 - mutations and genetic drift
 - factors affecting the survival of an organism
 - natural selection.

Strand II: The Content of Science

Standard III (Earth and Space Science): Understand the structure of Earth, the solar system, and the universe, the interconnections among them, and the processes and interactions of Earth's systems.

9-12 Benchmark II: Examine the scientific theories of the origin, structure, energy, and evolution of Earth and its atmosphere, and their interconnections.

Grade 9-12 Performance Standards

Geochemical Cycles

9. Know that Earth's system contains a fixed amount of natural resources that cycle among land, water, the atmosphere, and living things (e.g., carbon and nitrogen cycles, rock cycle, water cycle, ground water, aquifers).

Strand III: Science and Society

Standard I: Understand how scientific discoveries, inventions, practices, and knowledge influence, and are influenced by, individuals and societies.

9-12 Benchmark I: Examine and analyze how scientific discoveries and their applications affect the world, and explain how societies influence scientific investigations and applications.

ACTIVITY

(Set up microscope or magnifying glass. Set out dead bark beetles for the students to look at. Explain that the pine bark beetles in Arizona/New Mexico are generally of the genus *Ips* or *Dendroctonus*. You can tell the difference between the two genus by the shape of the beetles' rear ends. Point out the difference to the students. See if they can see the difference using the microscope/magnifying glass. Also, tell them that different species of beetles can attack the same tree. So, you might have *Ips* and *Dendroctonus* beetles in the same tree!)

ACTIVITY

(Note: This activity was adapted from "Saga of the Gypsy Moth" that appeared in "Project Learning Tree, The Changing Forest: Forest Ecology,"

http://www.plt.org/cms/pages/21_21_11.html.)

Now that we are all bark beetle experts, we are going to have some fun. First, I should ask you a question. Should bark beetles be controlled? (In other words, should people do something about them?) Why? How?

Those are good thoughts. We are going to explore this more in our next activity.

(Randomly divide students into five groups called "bark beetle management teams." The five teams will be:

1. No Control
2. Cultural Control
3. Mechanical or Manual Control
4. Biological Control
5. Chemical Control

Give each group a copy of their "bark beetle control team card" so they understand their management strategy better.)

You will be using a technique called the "Power of Persuasion" to convince the other teams and your teacher that your management strategy is the best. (Pass out a copy of the "Power of Persuasion" student page to each group.) Before your team gets started, you should each take a look at this student page to get some hints on persuading people and organizing your arguments.



Each team will get five minutes or less to present their argument. The other

Grade 9-12 Performance Standards

Science and Technology

12. Explain how societies can change ecosystems and how these changes can be reversible or irreversible.

LANGUAGE ARTS

Strand: Reading and Listening for Comprehension

Content Standard I: Students will apply strategies and skills to comprehend information that is read, heard, and viewed.

9-12 Benchmark I-B: Synthesize and evaluate information to solve problems across the curriculum.

Grade 9 Performance Standards

1. Use a variety of techniques for researching topics including:
 - cross-referencing while gathering information
 - summarizing dialogue
 - using news sources (e.g., newspapers, magazines, TV, radio, videotapes, Internet, email, government publications, microfiche, other library resources)

Grade 10 Performance Standards

3. Use multiple resources to gather information to evaluate problems, examine cause and effect relationships, and answer research questions to inform an audience.

Grade 12 Performance Standards

1. Identify and defend research questions and topics that will be important in the future.
2. Use a variety of resources to gather information to critically analyze texts to gain meaning, develop thematic connections, and synthesize ideas.
3. Demonstrate increasing sophistication in the selection and use of resources to define issues and use argument effectively.

9-12 Benchmark I-C: Demonstrate critical thinking skills to evaluate information and solve problems.

Grade 9 Performance Standards

1. Examine texts for arguments and develop informed opinions by:
 - examining relevant reason and evidence
 - noting the progression of ideas that substantiate the proposal
 - analyzing the style, tone, and use of language for a particular effect
 - identifying and analyzing personal, social, historical, or cultural influences, contexts, or biases
 - identifying and analyzing rhetorical strategies that support proposals

teams will not interrupt the presenting team. After your five minutes, your team will sit down and listen to the other teams' arguments. At the end of your presentations, your teacher will be the one to decide which control method he/she thinks would work the best. So, the teacher is like our district ranger. All the specialists present their points of view and then the district ranger decides which one to go with. (Put the ranger hat on the teacher.)

Now, we'll take 10 minutes so each team can talk about their management strategy, plan their argument and arrange their presentation. During the 10 minutes, I will be available to answer any questions that your team might have.

(Call each group up to present. Time them. Stop them after five minutes if they are still talking. At the end, have the teacher pick which management strategy to go with and have him/her explain why he/she picked that one.)

Now that we know what your teacher would do, let's find out what real bark experts recommend.

Prevention is the best way to reduce losses due to bark beetles. Healthy trees are usually not attacked. Those trees that are stressed by disease and overcrowding are more prone to attack. Knowing that, one way to improve the chances for a tree to survive is to make it healthier. If natural precipitation is below normal during the fall and winter, trees benefit from being irrigated. You remember that we talked about how important water is in supporting the tree's natural defense mechanism – pitch. So, in simple terms, you can water the tree. Watering the tree would fall under which management strategy? Cultural. Applications of fertilizers will not help protect trees from the effects of drought and will not protect them against bark beetle attacks.

But, you can't water all the trees in the forest. There is not enough water anywhere to do that! So, what can you do to help the forest as a whole. The answer is to find a way to relieve overcrowding so that the trees that remain have greater access to water and nutrients. The best way we know to reduce overcrowding is through thinning – where we cut down trees – and prescribed burning – where we use management-ignited fire to kill off some of the trees. Which management strategy would thinning and prescribed burning fall under? Mechanical.

Another way to protect your favorite trees from bark beetles is through the use of insecticides. Before I go into details, I

2. Support informed opinions by providing relevant and convincing reasons, using various types of evidence, language, and organizational structure, and demonstrating an awareness of possible questions, concerns, or counter-arguments.

Grade 10 Performance Standards

1. Examine controversial issues by:
 - sharing and evaluating personal response
 - researching and summarizing data
 - developing a framework in which to discuss the issue (creating the context)
 - compiling personal responses and researched data to organize the argument
 - presenting data in various forms (e.g., graph, essay, speech, video)

Grade 11 Performance Standards

1. Use language persuasively in addressing a particular issue by:
 - finding and interpreting information effectively
 - establishing and defending a particular perspective
 - responding respectfully to viewpoints and biases

Grade 12 Performance Standards

1. Research, define, and present issues of public concern by:
 - specifying the nature of an issue, including claims made and the reasoning that supports those claims
 - organizing and delivering a presentation that specifies reasons for the claim and makes a clear stance on the issue.

9-12 Benchmark I-D: Apply knowledge of reading process to evaluate print, non-print, and technology-based information.

Grade 9 Performance Standards

1. Explain meaning, describe processes, and answer research questions to inform others by:
 - demonstrating the ability to read and listen to explanatory texts using appropriate preparation, engagement, and reflection
 - demonstrating comprehension of major ideas
 - summarizing major steps
 - determining accuracy and clarity of the selection

Grade 10 Performance Standards

1. Pose questions prompted by text and research answers by:
 - prioritizing and organizing information to construct a complete and reasonable explanation
3. Demonstrate increasing comprehension and ability

should tell you that there is no way to save a tree once it has been attacked by bark beetles. Even if it is still green, if there are beetles in it, it will eventually die. There is nothing that can be done about that. However, insecticides can be used as a protective measure before the tree is attacked. Preventive spraying involves the application of pesticides and is usually performed by commercial applicators. Because of the associated environmental considerations and the expense of getting this work done, it is neither practical nor advisable to spray every tree on a tract of land. It truly is for only your high-value trees – the ones you really don’t want to lose. There is no way we could spray it across the forest for two reasons. First, the cost would be astronomical. Second, it would be terrible for the environment! Which management strategy would preventive spraying fall under? Chemical.

Some other things people can do to try to prevent bark beetle attack:

- Only cut down trees at certain times of year. Remember that bark beetles are attracted to tree slash. If you cut down trees in late summer and fall, that allows the debris to dry out and become less suitable for beetles. (Management Strategy – Cultural)
- Destroying debris by chipping it or burning it can also prevent problems. (Management Strategy – Mechanical)
- Avoid collecting firewood from an area with a beetle infestation. (Management Strategy – Cultural)

Even though experts have largely focused on cultural, mechanical and chemical controls, that does not mean that the other management strategies do not have value. In fact, the management strategies of “no control” and “biological control” are really the ones that will play a big role in the long-term. Much of the current explosion in beetle populations that we are seeing now is due to the drought in our area. When precipitation levels return to normal, beetle populations will naturally decline. That doesn’t mean that we shouldn’t continue thinning and burning though! Our forests truly are overcrowded, and we have to take action now so that our trees won’t be decimated by beetles, disease and wildfire.

CLOSING

I really enjoyed being here with you today. I hope you learned a lot about the bark beetle. I encourage you to give us a call at the _____ National Forest if you are interested in learning more.

to respond personally to texts by selecting and exploring a wide range of works that relate to an issue, author, or theme.

Grade 11 Performance Standards

3. Recognize how new information changes one’s personal knowledge base.

Strand: Speaking and Writing for Expression

Content Standard II: Students will communicate effectively through speaking and writing.

9-12 Benchmark II-A: Communicate information in a coherent and persuasive manner using verbal and non-verbal language.

Grade 9 Performance Standards

1. Evaluate personal effectiveness in group discussions and make corrections as necessary.
2. Ask questions to broaden and enrich discussions.
3. Express an informed opinion that clearly states a personal view, is logical and coherent, and engages the reader’s interest.
4. Support an informed opinion by using appropriate language, reason, and organizational structure for the audience and purpose.

Grade 10 Performance Standards

2. Make well-informed and well-organized formal presentations with a clear main point, adjusting the message, wording, and delivery to the particular audience and context.

Grade 11 Performance Standards

1. Use language persuasively in addressing a particular issue by:
 - finding and interpreting information effectively
 - recognizing propaganda as a purposeful technique
 - establishing and defending a point of view
 - responding respectfully to viewpoints and biases

Grade 12 Performance Standards

1. Develop oral formal presentations using clear enunciation, gestures, tone, vocabulary, and organization appropriate for a particular audience.
2. Make explicit use of various techniques for effective presentations (e.g., voice, inflection, tempo, gestures).

9-12 Benchmarks II-C: Demonstrate competence in the skills and strategies of the writing process to inform and persuade

Grade 9 Performance Standards

3. Compose written arguments that develop and support informed opinions by:
 - stating a progression of ideas

HANDOUT

No handout.

SUPPLIES

- Pieces of bark with beetle galleries
- Dead bark beetles
- Beetle larva or pupa, if available
- Magnifying glass or microscope
- Bark beetle control team cards (one per group)
- “Power of Persuasion” student page (one per group)
- Ranger hat (one)
- Stopwatch

- selecting appropriate style, tone, and use of language for a particular effect
- describing and analyzing personal, social, historical, or cultural influences
- presenting rhetorical strategies to support the proposal

Grade 10 Performance Standards

2. Clearly articulate a position through the use of a thesis statement, anticipate and deal with counter-arguments, and develop arguments using a variety of methods such as:
 - examples and details
 - commonly accepted beliefs
 - expert opinions
 - quotations and citations
 - cause and effect
 - comparison and contrast reasoning
3. Differentiate among literal, figurative, and connotative meanings.

Grade 11 Performance Standards

1. Use argument to:
 - interpret researched information
 - establish and defend a point of view
 - address concerns of the opposition
2. Synthesize and organize information from a variety of sources in order to inform and persuade an audience.

Grade 12 Performance Standards

3. Analyze own work for:
 - consistency of facts, ideas, tone, voice
 - development of argument or plot
 - clarity and conciseness

SOCIAL STUDIES

Strand: Geography

Content Standard II: Students understand how physical, natural, and cultural processes influence where people live, the ways in which people live, and how societies interact with one another and their environments.

9-12 Benchmark II-A: Analyze and evaluate the characteristics and purposes of geographic tools, knowledge, skills, and perspectives, and apply them to explain the past, present, and future in terms of patterns, events, and issues.

Grade 9-12 Performance Standards

1. Evaluate and select appropriate geographic representations to analyze and explain natural and man-made issues and problems.
2. Understand the vocabulary and concepts of spatial interaction, including an analysis of population distributions and settlements patterns.

9-12 Benchmark II-B: Analyze natural and man-made

characteristics of worldwide locales; describe regions, their interrelationships, and patterns of change.

Grade 9-12 Performance Standards

1. Analyze the interrelationships among natural and human processes that shape the geographic connections and characteristics of regions, including connections among economic development, urbanization, population growth, and environmental change.
2. Analyze how the character and meaning of a place is related to its economic, social, and cultural characteristics, and why diverse groups in society view places and regions differently.
3. Analyze and evaluate changes in regions and recognize the patterns and causes of those changes (e.g., mining, tourism).

9-12 Benchmark II-C: Analyze the impact of people, places, and natural environments upon the past and present in terms of our ability to plan for the future.

Grade 9-12 Performance Standards

2. Compare and contrast how different viewpoints influence policy regarding the use and management of natural resources.
3. Analyze the role that spatial relationships have played in effecting historic events.
4. Analyze the use of and effectiveness of technology in the study of geography.

9-12 Benchmark II-D: Analyze how physical processes shape the Earth's surface patterns and biosystems.

Grade 9-12 Performance Standards

1. Analyze how the Earth's physical processes are dynamic and interactive.
2. Analyze the importance of ecosystems in understanding environments.
3. Explain and analyze how water is a scarce resource in New Mexico, both in quantity and quality.

9-12 Benchmark II-E: Analyze and evaluate how economic, political, cultural, and social processes interact to shape patterns of human populations, and their interdependence, cooperation, and conflict.

Grade 9-12 Performance Standards

6. Analyze how differing points of view and self-interest play a role in conflict over territory and resources (e.g., impact of culture, politics, strategic locations, resources).

9-12 Benchmark II-F: Analyze and evaluate the effects of human and natural interactions in terms of changes in the meaning, use, distribution, and importance of resources in order to predict our global capacity to support human activity.

Grade 9-12 Performance Standards

1. Compare the ways man-made and natural processes modify the environment and how these modifications impact resource allocations.
2. Analyze how environmental changes bring about and impact resources.

FOREST SERVICE CONSERVATION EDUCATION LEARNER GUIDELINES

Program title: Saga of the Bark Beetle

Target audience: High School Biology

Primary topic: There are costs and benefits to different land management strategies.

Length of program: 1 to 1.25 hours

Setting: indoors

Guidelines addressed are referenced here:

9-adult
I. Questioning and Analysis Skills
A1, A2, A3, G1
II. Knowledge of Environmental Processes and Systems
1. A3, B1, B2
2. A1, B1, C2, C4, D3
3. A1, C2, E1
4. A1, A2, A3, A4, B1, B3, C3, C4, E1
III. Skills for Understanding and Addressing Environmental Issues
1. A1, A2, A3, B1, B2, B3, B4, C1, C2, C4, D1
2. A1, A4, B1, D1
IV. Personal and Civic Responsibility
C1, C2, D1, D2, D4

Power of Persuasion

Here are a few tips to help persuade others to see your point of view:

- ▶ **Organize your thoughts and concepts logically.**
You may want to jot on a notecard your major points in order of priority so you don't forget them.
- ▶ **Start with an attention-getter.**
Open with a powerful statement to grab the attention of your audience.
- ▶ **Clearly explain your point of view.**
Give specific examples, if you can, to illustrate your position.
- ▶ **Be Concise.**
Keep it short and simple! Short speeches are usually more powerful and memorable than longer ones.
- ▶ **Make eye contact.**
Eye contact shows that you are sincere about your topic and that you acknowledge your audience.
- ▶ **Speak slowly.**
Most people tend to rush when they talk before a group. Speak slowly and loudly enough so everyone can easily hear you.
- ▶ **Use visuals.**
You may want to highlight major points by writing them on a chalkboard, easel pad, or handout; showing slides, a poster, or other pictures will help people remember important points.
- ▶ **Reinforce your position and your argument.**
After you introduce your position and your argument, you should articulate your position, then conclude by reiterating the major points of your argument.



Student Page

Bark Beetle Control Team Cards

NO CONTROL: Your team advocates doing nothing, which allows natural biological controls to function in the forest. Your team hopes that outbreak populations will be brought back to nondamaging levels by those natural controls before causing significant social or economic damage.

If your team has any questions about the bark beetle, please ask the facilitator.

CULTURAL CONTROL: Your team focuses on cultural practices, such as planting trees that pine bark beetles do not use. Cultural practices could also include improving the health of trees through various means so that the trees can better withstand a bark beetle attack.

If your team has any questions about the bark beetle, please ask the facilitator.

MECHANICAL OR MANUAL CONTROL: Your team focuses on mechanical practices that change the bark beetles' access to food and their ability to reproduce. Your team might advocate various ways to treat slash to try to prevent bark beetle infestation. Your team might also advocate various ways of treating the forest so that it is better able to withstand a bark beetle infestation.

If your team has any questions about the bark beetle, please ask the facilitator.

BIOLOGICAL CONTROL: Your team focuses on biological controls, such as introducing natural enemies (parasites, predators, and disease organisms) to maintain bark beetle populations at nondamaging levels.

If your team has any questions about the bark beetle, please ask the facilitator.

CHEMICAL CONTROL: Your team advocates using chemicals to eradicate or manage the bark beetle. Your team may advocate using broad-spectrum synthetic chemicals that are poisonous to many insects and other organisms. Your team may also advocate using sprays derived from natural products that are generally restricted to killing invertebrates.

If your team has any questions about the bark beetle, please ask the facilitator.